

## CLAIMS

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1. A method of determining a respective process value of at least one input variable governing a plasma process sequence for creating a desired surface profile on a process substrate, the method comprising the steps of:
  4. a. selecting a respective test value of the at least one input variable;
  5. b. subjecting a test substrate to a test process defined by the respective test value, thereby creating a test surface profile;
  6. c. providing an initial surface profile model in terms of the at least one input variable and at least one unknown coefficient;
  7. d. generating an approximate profile prediction from the initial surface profile model and the respective test value of the at least one input variable;
  8. e. generating an indicator of difference between the test surface profile and the approximate profile prediction;
  9. f. generating a respective optimum value of the at least one unknown coefficient that minimizes the indicator of difference;
  10. g. modifying the initial surface profile model to include the at least one optimum value, thereby providing a final model in terms of the at least one input variable; and
  11. h. generating the respective process value of the at least one input variable from the final model and the desired surface profile.
12. 2. The method of claim 1 wherein the at least one unknown coefficient comprises a plurality of unknown coefficients.
13. 3. The method of claim 1 wherein the at least one input variable comprises a plurality of input variables, the approximate profile prediction being generated from the initial surface profile model and the respective test values of each of the plurality of input variables.

1 4. The method of claim 1 wherein the test surface profile comprises a plurality of  
2 snapshots, the approximate profile prediction including a frame corresponding to each  
3 snapshot, the step of generating an indicator of difference between the test surface profile  
4 and the approximate profile prediction including pairwise comparison of each snapshot  
5 with the respective corresponding frame.

1 5. The method of claim 1 wherein generating an approximate profile prediction includes  
2 using a respective rough preliminary value of the at least one unknown coefficient.

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1 6. The method of claim 35 wherein generating a respective optimum value of the at least  
2 one unknown coefficient includes changing at least one of said at least one respective  
3 rough preliminary value of the at least one unknown coefficient and comparing the test  
4 surface profile and the approximate profile prediction incorporating the at least one  
5 changed value.

1 7. The method of claim 1 wherein the indicator of difference is generated by a  
2 multidimensional nonlinear least-squares technique.

1 8. A method of processing a process substrate to create a desired surface profile thereon,  
2 the process comprising the step of applying a plasma process to the process substrate, the  
3 plasma process being defined by the respective process value of the at least one input  
4 variable determined by the method of claim 1.

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1 9. A device made by processing a process substrate as defined in claim 4.

*Sub a3*

1 10. A method of predictively calculating a process surface profile to be created on a  
2 process substrate by a plasma process sequence defined by a respective process value of  
3 at least one input variable, the method comprising the steps of:

4 a. selecting a respective test value of the at least one input variable, at least one of  
5 said at least one respective test value being unequal to at least one of said at least one  
6 respective process value;

7 b. subjecting a test substrate to a test process defined by the respective test value,  
8 thereby creating a test surface profile;

9 c. providing an initial surface profile model in terms of the at least one input  
10 variable and at least one unknown coefficient;

11 d. generating an approximate profile prediction from the initial surface profile  
12 model and the respective test value of the at least one input variable;

13 e. generating an indicator of difference between the test surface profile and the  
14 approximate profile prediction;

15 f. generating a respective optimum value of the at least one unknown coefficient  
16 that minimizes the indicator of difference;

17 g. modifying the initial surface profile model to include the at least one optimum  
18 value, thereby providing a final model in terms of the at least one input variable; and

19 h. introducing the respective process value of the at least one input variable into  
20 the final model, thereby forming a description of the process surface profile.

1 11. The method of claim 10 wherein the at least one unknown coefficient comprises a  
2 plurality of unknown coefficients.

1 12. The method of claim 10 wherein the at least one input variable comprises a plurality  
2 of input variables, the approximate profile prediction being generated from the initial  
3 surface profile model and the respective test values of each of the plurality of input  
4 variables.

1 13. The method of claim 10 wherein the test surface profile comprises a plurality of  
2 snapshots, the approximate profile description including a frame corresponding to each  
3 snapshot, the step of generating an indicator of difference between the test surface profile

4 and the approximate profile description including pairwise comparison of each snapshot  
5 with the respective corresponding frame.

1 14. The method of claim 10 wherein generating an approximate profile description  
2 includes using a respective rough preliminary value of the at least one unknown  
3 coefficient.

1 15. The method of claim 14 wherein generating a respective optimum value of the at  
2 least one unknown coefficient includes changing at least one of said at least one  
3 respective rough preliminary value of the at least one unknown coefficient and comparing  
4 the test surface profile and the approximate profile prediction incorporating the at least  
5 one changed value.

1 16. The method of claim 10 wherein the indicator of difference is generated by a  
2 multidimensional nonlinear least-squares technique.

1 17. The method of claim 10 wherein the respective process value of the at least one input  
2 variable varies with time.

18. A method of configuring an apparatus for processing a process substrate according to  
a plasma process sequence defined by a respective process value of at least one input  
variable, the apparatus including a plasma reactor, the at least one input variable  
including at least one reaction variable, the method comprising the steps of:  
a. selecting a respective test value of the at least one input variable;  
b. subjecting a test substrate to a test process defined by the respective test value,  
thereby creating a test surface profile;  
c. providing an initial surface profile model in terms of the at least one input  
variable and at least one unknown coefficient;

10           d. generating an approximate profile prediction from the initial surface profile  
11          model and the respective test value of the at least one input variable;  
12           e. generating an indicator of difference between the test surface profile and the  
13          approximate profile prediction;  
14           f. generating a respective optimum value of the at least one unknown coefficient  
15          that minimizes the indicator of difference;  
16           g. modifying the initial surface profile model to include the at least one optimum  
17          value, thereby providing a final model in terms of the at least one input variable;  
18           h. generating the respective process value of the at least one input variable from  
19          the final model and the desired surface profile; and  
20           i. configuring the reactor to process the process substrate according to the derived  
21          respective process value of the at least one reaction variable.

1       19. An apparatus for determining a respective process value of at least one input variable  
2          governing a plasma process sequence for creating a desired surface profile on a process  
3          substrate, the apparatus comprising:  
4           a. a computer memory for storing the desired surface profile;  
5           b. a computer memory for storing a test surface profile, created by subjecting a  
6          test substrate to a test process defined by a respective test value of the at least one input  
7          variable;  
8           c. means for generating an initial surface profile model in terms of the at least one  
9          input variable and at least one unknown coefficient;  
10           d. means for generating an approximate profile description from the initial  
11          surface profile model and the respective test value of the at least one input variable;  
12           e. means for generating an indicator of difference between the test surface profile  
13          and the approximate profile prediction;  
14           f. means for generating a respective optimum value of the at least one unknown  
15          coefficient that minimizes the indicator of difference;

16                   g. means for modifying the initial surface profile model to include the at least one  
17 optimum value, thereby providing a final model in terms of the at least one input  
18 variable; and

19                   h. means for generating the respective process value of the at least one input  
20 variable from the final model and the desired surface profile.

1       20. The apparatus of claim 19 wherein the test surface profile comprises a plurality of  
2 snapshots, the approximate profile prediction including a frame corresponding to each  
3 snapshot, the means for generating an indicator of difference between the test surface  
4 profile and the approximate profile prediction being configured so as to compare each  
5 snapshot with the respective corresponding frame.

1       21. The apparatus of claim 19 further comprising a computer memory for storing a  
2 respective rough preliminary value of the at least one unknown coefficient, the means for  
3 generating an approximate profile description from the initial surface profile model and  
4 the respective test value of the at least one input variable employing the respective rough  
5 preliminary value.

1       22. The method of claim 21 wherein the means for generating a respective optimum  
2 value of the at least one unknown coefficient is configured to change at least one of said  
3 at least one respective rough preliminary value of the at least one unknown coefficient  
4 and to compare the test surface profile and the approximate profile prediction  
5 incorporating the at least one changed value.

1       23. The method of claim 19 wherein the means for generating an indicator of difference  
2 between the test surface profile and the approximate profile prediction employs a  
3 multidimensional nonlinear least-squares technique.

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1 24. An apparatus for predictively calculating a process surface profile to be created on a  
2 process substrate by a plasma process sequence defined by a respective process value of  
3 at least one input variable, the method comprising the steps of:  
4       a. a computer memory for storing the respective process value;  
5       b. a computer memory for storing a test surface profile, created by subjecting a  
6 test substrate to a test process defined by a respective test value of the at least one input  
7 variable;  
8       c. means for generating an initial surface profile model in terms of the at least one  
9 input variable and at least one unknown coefficient;  
10      d. means for generating an approximate profile prediction from the initial model  
11 and the respective test value of the at least one input variable;  
12      e. means for generating an indicator of difference between the test surface profile  
13 and the approximate profile prediction;  
14      f. means for generating a respective optimum value of the at least one unknown  
15 coefficient that minimizes the indicator of difference;  
16      g. means for modifying the initial surface profile model to include the at least one  
17 optimum value, thereby providing a final model in terms of the at least one input  
18 variable; and  
19      h. means for introducing the respective process value of the at least one input  
20 variable into the final model, thereby forming a description of the process surface profile.

1 25. The apparatus of claim 24 wherein the test surface profile comprises a plurality of  
2 snapshots, the approximate profile prediction including a prediction corresponding to  
3 each snapshot, the means for generating an indicator of difference between the test  
4 surface profile and the approximate profile prediction being configured so as to compare  
5 each snapshot with the respective corresponding prediction.

1 26. The apparatus of claim 24 further comprising a computer memory for storing a  
2 respective rough preliminary value of the at least one unknown coefficient, the means for

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3 generating an approximate profile prediction employing the respective rough preliminary  
4 value.

1 27. The method of claim 26 wherein the means for generating a respective optimum  
2 value of the at least one unknown coefficient is configured to change at least one of said  
3 at least one respective rough preliminary value of the at least one unknown coefficient  
4 and to compare the test surface profile and the approximate profile prediction  
5 incorporating the at least one changed value.

1 28. The method of claim 24 wherein the means for generating an indicator of difference  
2 between the test surface profile and the approximate profile prediction employs a  
3 multidimensional nonlinear least-squares technique.

1 *29.* The method of claim 1 further comprising the step of applying a plasma process to  
2 the process substrate, the plasma process being defined by the respective process value of  
3 the at least one input variable.